BİRTH METHODS AND CURRENT DEVELOPMENTS:

Traditional Approaches, Innovative Technologies and the Future of Childbirth

YAZAR:
REMZİ KARASUNGUR

BİDGE

BİDGE Yayınları

Bırth Methods and Current Developments: Traditional Approaches, İnnovative Technolohies and the Future of Childbirth

Yazar: Remzi Karasungur

ISBN: 978-625-8821-57-4

1st Edition

Page Layout By: Gözde YÜCEL

Publication Date: 25.06.2026

BİDGE Yayınları

www.bidgeyayinlari.com.tr - bidgeyayinlari@gmail.com
Krc Bilişim Ticaret ve Organizasyon Ltd. Şti.
Güzeltepe Mahallesi Abidin Daver Sokak Sefer Apartmanı No: 7/9 Çankaya / Ankara

TABLE OF CONTENTS

PREFACE

Childbirth is one of the most remarkable physiological processes in human life and represents a unique transition that profoundly influences the health and well-being of both the mother and the newborn. Although birth is fundamentally a natural biological event, it is also a complex process affected by medical, psychological, technological, social, and cultural factors. Throughout history, childbirth practices have evolved continuously in response to advances in medical science, improvements in healthcare systems, and changing expectations regarding maternal and neonatal care. Today, the primary objective of modern obstetric practice is not only to ensure a safe birth but also to provide an individualized, evidence-based, and positive childbirth experience.

During the past decades, remarkable developments in obstetrics have transformed childbirth care. While conventional approaches such as spontaneous vaginal birth, assisted vaginal birth, epidural analgesia, water birth, and cesarean section continue to constitute the foundation of maternity services, innovative technologies are increasingly shaping the future of childbirth. Artificial intelligence-supported clinical decision systems, virtual reality-assisted labor analgesia, telemetric fetal monitoring, smart birth simulators, wearable technologies, and personalized digital birth planning are emerging as promising tools that have the potential to improve maternal and neonatal outcomes while enhancing women's childbirth experiences.

These innovations have also expanded the responsibilities of healthcare professionals. Midwives, nurses, and obstetricians are expected not only to possess strong clinical competencies but also to integrate rapidly developing technologies into patient-centered care while preserving the physiological nature of childbirth. Therefore,

understanding both conventional birth methods and emerging technological innovations has become increasingly important for healthcare professionals, researchers, and students involved in maternal and newborn care.

This book was prepared with the aim of presenting a comprehensive overview of current childbirth methods together with the latest scientific developments that are expected to influence the future of obstetric practice. Rather than promoting a single mode of birth, this book evaluates each childbirth method within the context of current scientific evidence, emphasizing its indications, benefits, limitations, and potential future applications. Furthermore, recently emerging technologies that are currently under development or early clinical implementation are discussed from clinical, ethical, and technological perspectives. The content of this book has been developed by reviewing contemporary international literature, clinical guidelines, and evidence-based publications in obstetrics, midwifery, nursing, and digital health. Every effort has been made to present accurate, up-to-date, and practical information that can contribute to both academic education and clinical practice. Because childbirth science continues to evolve rapidly, readers are encouraged to interpret the information presented in light of newly emerging evidence and updated international recommendations.

We sincerely hope that this book will serve as a valuable resource for obstetricians, midwives, nurses, healthcare professionals, researchers, undergraduate and postgraduate students, and everyone interested in maternal and newborn health. If this work contributes, even modestly, to improving childbirth care, promoting evidence-based practice, and supporting safe and respectful maternity services, it will have achieved its primary purpose.

CHAPTER I

INTRODUCTION

Childbirth represents one of the most significant physiological events in human life and remains a fundamental component of maternal and newborn health worldwide. Throughout history, childbirth practices have continuously evolved in response to advances in medical knowledge, technological innovation, and changing expectations regarding maternal safety, comfort, and individualized care. Although childbirth is a natural physiological process, modern obstetric care increasingly seeks to balance safety with the preservation of physiological birth, emphasizing evidence-based practices that improve maternal and neonatal outcomes while minimizing unnecessary interventions.

In Türkiye, the total fertility rate declined to 1.48 in 2024, and national projections indicate that this downward trend is expected to continue throughout 2025 and 2026 (Turkish Statistical Institute, 2025). Although multiple demographic, socioeconomic, and healthcare-related factors contribute to declining fertility, childbirth-related factors have increasingly attracted scientific attention. In particular, the growing prevalence of cesarean section and fear of childbirth have been identified as important factors

influencing women's reproductive intentions and decisions regarding future pregnancies (Çitak, Çakir, & Toker, 2025; Kedir, Bekele, & Tefera, 2025). Consequently, improving childbirth experiences has become an important public health objective not only for maternal well-being but also for supporting long-term reproductive health.

To address these challenges, Türkiye has implemented several national initiatives aimed at promoting physiological childbirth while ensuring maternal and neonatal safety. The Ministry of Health's "Natural Childbirth Is Normal" Action Plan, together with the "A Midwife for Every Pregnant Woman" Project, emphasizes continuity of care throughout pregnancy, childbirth, and the postpartum period. Complementing these initiatives, the digital platform "Journey to Motherhood" provides evidence-based education and individualized guidance for pregnant women through technology-supported healthcare services. By promoting positive childbirth experiences, reducing unnecessary primary cesarean deliveries, and preventing secondary tokophobia, these national strategies aim to contribute to sustainable improvements in maternal health and national fertility indicators (LGAZ, 2025).

Recent advances in obstetric science indicate that childbirth care is entering a new era characterized by personalized, technology-assisted, and evidence-based approaches. As of 2026, a paradigm shift is occurring in the philosophy of childbirth. Traditional intervention-oriented models are gradually evolving toward approaches that prioritize physiological birth, individualized comfort, maternal autonomy, and minimal intervention whenever clinically appropriate. Within this framework, digital innovations no longer function primarily as tools designed to accelerate or standardize labor; instead, they serve as intelligent support systems

that continuously monitor maternal and fetal well-being while preserving the natural progression of childbirth.

Artificial Intelligence (AI), wearable maternal-fetal monitoring devices, wireless telemetry systems, digital birth simulators, and Virtual Reality (VR)-based pain management technologies represent some of the most promising developments currently shaping the future of obstetric care. These technologies enable healthcare professionals to make more accurate clinical decisions through continuous data analysis, facilitate individualized birth planning, support maternal mobility during labor, and improve communication between healthcare providers and expectant mothers. Rather than replacing the clinical expertise of obstetricians, midwives, and nurses, these innovations are intended to strengthen evidence-based decision-making while maintaining the human-centered nature of maternity care (Smith & Rahmani, 2026).

At the same time, technological innovation introduces new ethical, legal, and organizational responsibilities. Ensuring data privacy, maintaining cybersecurity, minimizing algorithmic bias, obtaining informed consent, and providing equitable access to innovative healthcare technologies have become increasingly important considerations for modern obstetric practice. Consequently, successful implementation of emerging childbirth technologies requires not only scientific advancement but also multidisciplinary collaboration among healthcare professionals, biomedical engineers, researchers, policymakers, and healthcare institutions.

This book aims to provide healthcare professionals, researchers, educators, students, and policymakers with a comprehensive overview of current childbirth methods and emerging birth technologies. It examines the scientific principles, clinical applications, advantages, limitations, ethical considerations,

and future perspectives of both established and innovative approaches to childbirth. By integrating current scientific evidence with contemporary technological developments, this book seeks to contribute to the advancement of safe, individualized, evidence-based, and woman-centered maternity care.

The following chapters examine both established and emerging childbirth methods, discussing their scientific foundations, clinical applications, advantages, limitations, and potential contributions to the future of maternity care.

CHAPTER II

CURRENT CHILDBIRTH METHODS AND THEIR BENEFITS

Contemporary obstetric practice offers a wide spectrum of childbirth methods designed to meet the diverse clinical needs, preferences, and medical conditions of pregnant women. The selection of an appropriate birth method depends on maternal and fetal health status, obstetric history, pregnancy-related complications, available healthcare resources, and informed maternal preferences. Although spontaneous vaginal birth remains the preferred approach for uncomplicated pregnancies, advances in obstetric medicine have expanded the range of evidence-based alternatives that enhance maternal comfort, optimize neonatal outcomes, and improve the overall childbirth experience.

Each childbirth method possesses unique indications, benefits, and clinical considerations. Therefore, healthcare professionals should adopt an individualized, woman-centered approach when recommending a birth method, taking into account maternal expectations together with current scientific evidence. The following sections present the most commonly practiced childbirth methods and discuss their clinical applications, advantages, and contributions to contemporary maternity care.

2.1. Spontaneous (natural) vaginal birth

Spontaneous vaginal birth is widely recognized as the physiological process of childbirth and remains the preferred method of delivery for healthy pregnant women when no medical or obstetric contraindications are present. It constitutes the cornerstone of modern maternity care and is strongly supported by the Turkish Ministry of Health through the "Natural Childbirth Is Normal" Action Plan and the "A Midwife for Every Pregnant Woman" Project, both of which emphasize the promotion of physiological birth, continuity of maternity care, and the reduction of unnecessary obstetric interventions (LGAZ, 2025).

From a maternal perspective, spontaneous vaginal birth is associated with fewer postoperative complications than surgical delivery, allowing faster recovery, earlier mobilization, shorter hospital stays, and more rapid resumption of daily activities. Furthermore, avoiding abdominal surgery significantly reduces the risks of postoperative infection, excessive postpartum hemorrhage, thromboembolic complications, and anesthesia-related adverse events (Cunningham et al., 2022).

For the newborn, passage through the birth canal provides important physiological advantages. Exposure to maternal vaginal microbiota contributes to the establishment of a healthy neonatal microbiome, supporting immune system maturation and long-term metabolic health. Simultaneously, mechanical compression of the fetal thorax during vaginal delivery facilitates the clearance of lung fluid, thereby reducing the incidence of transient respiratory disorders and improving early neonatal respiratory adaptation (Dominguez-Bello et al., 2019; Hansen et al., 2018).

The long-term reproductive benefits of spontaneous vaginal birth are equally important. Because no uterine scar is created, women experience substantially lower risks of placenta previa,

placenta accreta spectrum disorders, uterine rupture, and other placental implantation abnormalities in future pregnancies compared with repeated cesarean deliveries (Silver & Landon, 2020). Consequently, spontaneous vaginal birth contributes not only to favorable outcomes during the current pregnancy but also to the preservation of future reproductive health.

Although spontaneous vaginal birth is considered the optimal mode of delivery for most uncomplicated pregnancies, careful maternal and fetal assessment remains essential throughout labor. Continuous clinical evaluation enables healthcare professionals to identify deviations from normal labor progression and to implement timely interventions whenever maternal or fetal well-being becomes compromised. Thus, maintaining a balance between physiological childbirth and appropriate obstetric intervention remains a fundamental principle of evidence-based maternity care.

2.2. Vaginal delivery with epidural analgesia (pain-free childbirth)

Vaginal birth with epidural analgesia is one of the most widely used pharmacological pain management techniques in contemporary obstetric practice. The procedure involves the placement of an epidural catheter into the lumbar epidural space during the active phase of labor, allowing continuous or intermittent administration of local anesthetics and analgesic agents. By effectively reducing labor pain while preserving maternal consciousness, epidural analgesia enables women to actively participate in the childbirth process with substantially improved comfort (Preis et al., 2020).

Over the past decade, epidural analgesia has evolved beyond a simple pain relief technique to become an integral component of individualized maternity care. Modern low-dose protocols are

specifically designed to minimize motor blockade while maintaining effective analgesia, thereby allowing pregnant women to remain mobile, change positions during labor, and actively participate in the birth process. This woman-centered approach aligns with contemporary obstetric principles that emphasize maternal autonomy, personalized care, and positive childbirth experiences.

One of the greatest advantages of epidural analgesia is its ability to provide highly effective pain control without significantly impairing maternal awareness or cooperation during labor. Adequate pain relief contributes to lower maternal stress hormone levels, reduced anxiety, and improved overall birth satisfaction. Furthermore, women who experience severe fear of childbirth or tokophobia may particularly benefit from epidural analgesia, as effective pain management can increase confidence in vaginal birth and reduce childbirth-related psychological distress (Anim-Somuah et al., 2018).

Advances in anesthetic techniques have led to the widespread adoption of low-dose "walking epidural" protocols. These regimens preserve lower extremity motor function to a considerable extent, enabling women to maintain mobility, adopt different labor positions, and participate more actively in the physiological progression of childbirth. Maternal mobility may facilitate fetal descent and contribute positively to maternal comfort throughout labor (Cambiaghi, Comforti, & Torricelli, 2025).

From a neonatal perspective, contemporary evidence demonstrates that the limited systemic absorption of epidural medications has minimal clinical impact on newborn well-being. Studies have consistently shown no significant adverse effects on neonatal Apgar scores, early neurological adaptation, or immediate postnatal outcomes when epidural analgesia is appropriately administered and carefully monitored (Wong & McCarthy, 2023).

An additional clinical advantage of epidural analgesia is its flexibility in emergency obstetric situations. Should an urgent cesarean section become necessary because of fetal or maternal indications, the existing epidural catheter can often be used to rapidly establish surgical anesthesia without requiring general anesthesia. This facilitates timely obstetric intervention while avoiding many of the risks associated with emergency general anesthesia during pregnancy (Chestnut et al., 2020).

Despite its numerous benefits, epidural analgesia should always be considered within the context of individualized clinical decision-making. Appropriate patient counseling before labor is essential to ensure that women understand the expected benefits, possible side effects, and realistic expectations regarding pain relief. Continuous maternal and fetal monitoring, together with close collaboration among obstetricians, anesthesiologists, midwives, and nurses, remains fundamental to maximizing both maternal safety and childbirth satisfaction. Consequently, epidural analgesia should be regarded not merely as a pain management technique but as an important component of comprehensive, evidence-based, woman-centered maternity care.

2.3. Water birth (hydrotherapy-assisted birth)

Water birth, also referred to as hydrotherapy-assisted childbirth, is a physiological birth approach in which the pregnant woman remains in a specially designed birthing pool filled with warm water, generally maintained at 36–37°C, during the active phase of labor and, in selected cases, throughout the birth of the baby. In contemporary obstetric practice, water birth has become an increasingly popular non-pharmacological option that promotes maternal comfort while supporting the physiological progression of labor (Preis et al., 2020).

Modern maternity care emphasizes minimizing unnecessary interventions and encouraging maternal autonomy during childbirth. Within this philosophy, hydrotherapy provides an environment that enhances maternal mobility, facilitates spontaneous position changes, and promotes relaxation throughout labor. Consequently, water birth is considered an important component of individualized, woman-centered maternity care, particularly for healthy women experiencing uncomplicated pregnancies.

The therapeutic effects of warm water are primarily attributed to buoyancy, hydrostatic pressure, and thermal relaxation. Buoyancy reduces gravitational pressure on the maternal musculoskeletal system, allowing greater freedom of movement and decreasing physical fatigue during labor. Simultaneously, immersion in warm water promotes muscle relaxation, enhances endorphin secretion, and contributes to a reduction in pain perception, thereby decreasing the need for pharmacological analgesia, including epidural anesthesia (Cluett, Burns, & Cuthbert, 2018).

Hydrotherapy also provides several obstetric advantages that may facilitate physiological childbirth. Increased maternal relaxation promotes more efficient uterine contractions and encourages cervical dilation, while the ability to adopt upright or alternative birthing positions may assist fetal descent through the birth canal. Furthermore, relaxation of the pelvic floor muscles and increased elasticity of the perineal tissues may reduce the incidence of severe perineal trauma and decrease the routine need for episiotomy (Nutter et al., 2014).

For newborns, appropriately managed water birth has not been associated with increased neonatal morbidity when evidence-based clinical protocols are followed. Research indicates that maintaining appropriate water temperature, ensuring strict infection prevention measures, and carefully selecting eligible mothers

preserve the newborn's physiological diving reflex during underwater birth, without increasing the risks of respiratory compromise or neonatal infection (Bovbjerg et al., 2016).

Despite these benefits, water birth is not appropriate for every pregnancy. Careful maternal and fetal assessment before and throughout labor is essential to ensure clinical safety. Women with obstetric complications, suspected fetal compromise, maternal infection, excessive vaginal bleeding, or other high-risk pregnancy conditions may require alternative birth settings that allow continuous obstetric intervention. Therefore, appropriate patient selection remains one of the most important determinants of successful hydrotherapy-assisted childbirth.

Successful implementation of water birth also depends on the availability of trained multidisciplinary healthcare teams, standardized infection control procedures, and well-equipped birthing facilities. Midwives, nurses, and obstetricians play essential roles in monitoring maternal and fetal well-being, maintaining water quality and temperature, and recognizing situations requiring transfer from the birthing pool to conventional obstetric care. When these standards are maintained, hydrotherapy-assisted childbirth represents a safe, evidence-based, and effective option that enhances maternal comfort while preserving the physiological nature of childbirth.

2.4. Elective Cesarean Section

Elective cesarean section is a planned surgical procedure performed before the spontaneous onset of labor, either because of established obstetric or medical indications or, in selected circumstances, at the informed request of the pregnant woman. Common medical indications include breech presentation, placenta previa, multiple pregnancy, previous uterine surgery, and maternal

or fetal conditions that make vaginal birth unsafe. As one of the most frequently performed obstetric operations worldwide, elective cesarean section has become an integral component of modern maternity care, particularly in the management of high-risk pregnancies.

Advances in obstetric anesthesia, perioperative antibiotic prophylaxis, thromboprophylaxis, and refined surgical techniques have substantially improved the safety of cesarean delivery over recent decades. Nevertheless, cesarean section remains a major abdominal surgical procedure and should therefore be performed only after careful evaluation of maternal and fetal indications, together with comprehensive prenatal counseling regarding both its immediate and long-term implications.

For appropriately selected women, elective cesarean section offers several important maternal benefits. The planned nature of the procedure eliminates uncertainty regarding the timing of childbirth, allowing healthcare professionals to prepare multidisciplinary obstetric teams and enabling families to anticipate the birth experience more effectively. This predictability may reduce anxiety and provide psychological reassurance, particularly for women experiencing severe fear of childbirth or tokophobia (Mazzoni et al., 2016).

Elective cesarean delivery also decreases the risk of pelvic floor trauma associated with difficult vaginal births. Consequently, it may reduce the long-term incidence of urinary incontinence, pelvic organ prolapse, and certain pelvic floor dysfunctions that may develop later in life following complicated vaginal deliveries (Keag, Norman, & Stock, 2018). In pregnancies complicated by placenta previa, malpresentation, fetal macrosomia, or other significant obstetric conditions, elective cesarean section provides a safe alternative by preventing potentially life-threatening complications

such as acute fetal asphyxia, shoulder dystocia, or umbilical cord prolapse that may occur during attempted vaginal birth (Landon & Lynch, 2018).

Successful elective cesarean care extends beyond the surgical procedure itself. Preoperative assessment, evidence-based perioperative management, effective postoperative pain control, early mobilization, breastfeeding support, and multidisciplinary postpartum care all contribute to improved maternal recovery and neonatal well-being. Contemporary obstetric practice therefore emphasizes enhanced recovery protocols that facilitate earlier maternal mobility, reduce postoperative complications, and support mother–infant bonding whenever clinically feasible.

Although elective cesarean section provides substantial benefits in appropriately selected cases, it should not be regarded as a universal alternative to physiological childbirth. Because each subsequent cesarean delivery increases the likelihood of surgical adhesions, abnormal placental implantation, and operative complexity in future pregnancies, the long-term reproductive consequences should be carefully discussed during prenatal counseling. Shared decision-making between healthcare professionals and pregnant women remains fundamental to individualized maternity care, ensuring that maternal preferences are balanced with clinical evidence and obstetric safety.

Consequently, elective cesarean section should be viewed as an evidence-based surgical intervention that plays a vital role in modern obstetrics when medically indicated or carefully justified. Appropriate patient selection, individualized counseling, and multidisciplinary clinical management remain essential to optimizing maternal and neonatal outcomes while preserving future reproductive health.

2.5. Gentle cesarean (gentle/family-centered cesarean)

Gentle cesarean section, also known as family-centered cesarean section, is a modern obstetric approach designed to integrate the emotional and psychological benefits of vaginal birth into a necessary surgical delivery. While maintaining the highest standards of maternal and neonatal safety, this approach transforms the conventional operating room environment into one that promotes family participation, early parent–infant bonding, and a more positive childbirth experience. Consequently, gentle cesarean section has become an increasingly important component of contemporary woman-centered maternity care, particularly for women requiring planned or emergency cesarean delivery (Çitak, Çakir, & Toker, 2025).

Unlike the traditional surgical model, which primarily focuses on operative efficiency, gentle cesarean emphasizes the childbirth experience as a significant life event for both the mother and her family. Modifications such as dimmed lighting, reduced environmental noise, transparent surgical drapes, and the presence of a birth companion, when clinically appropriate, create a calmer atmosphere that helps reduce maternal anxiety and facilitates emotional involvement throughout the birth process.

A defining characteristic of gentle cesarean is the promotion of immediate skin-to-skin contact between the mother and newborn whenever maternal and neonatal conditions permit. Initiating skin-to-skin contact during or immediately after surgery facilitates early breastfeeding, enhances maternal oxytocin release, supports neonatal thermoregulation, and strengthens early parent–infant attachment (Crenshaw, 2014). These practices contribute to preserving many of the physiological and psychological benefits traditionally associated with vaginal birth despite the surgical nature of the delivery.

Early family-centered interventions also contribute positively to neonatal adaptation. Studies have demonstrated that newborns who experience immediate skin-to-skin contact following cesarean delivery exhibit improved stabilization of body temperature, heart rate, respiratory function, and early breastfeeding behaviors, comparable to those observed after uncomplicated vaginal births (Stevens et al., 2018). Furthermore, involving partners or family members in the birth experience promotes emotional support for the mother and enhances family satisfaction with the childbirth process.

Another important component of gentle cesarean is delayed umbilical cord clamping whenever clinically feasible. Together with uninterrupted maternal–newborn contact and early initiation of breastfeeding, this practice reflects the broader philosophy of preserving normal physiological transition after birth while maintaining surgical safety. Accordingly, gentle cesarean represents not merely a modification of surgical technique but a comprehensive model of family-centered maternity care that prioritizes both clinical excellence and humanistic care.

Successful implementation of gentle cesarean requires close collaboration among obstetricians, anesthesiologists, midwives, nurses, and neonatal healthcare professionals. Effective communication, coordinated multidisciplinary teamwork, and institutional protocols supporting family-centered care are essential for maintaining patient safety while preserving the emotional aspects of childbirth. Healthcare professionals also play a critical role in preparing expectant parents through antenatal counseling, ensuring that realistic expectations are established regarding both the surgical procedure and opportunities for family participation.

Although gentle cesarean offers substantial psychological and emotional advantages, its implementation should always remain

guided by maternal and neonatal clinical conditions. In situations requiring immediate emergency intervention or neonatal resuscitation, patient safety must remain the highest priority. Therefore, individualized clinical assessment is fundamental to determining the feasibility of family-centered practices during cesarean delivery.

Overall, gentle cesarean section represents an important evolution in modern obstetric care by demonstrating that surgical childbirth can preserve many of the emotional, psychological, and relational benefits traditionally associated with physiological birth. By combining evidence-based surgical practice with compassionate, woman-centered care, this approach contributes to improved maternal satisfaction, enhanced family involvement, and a more positive childbirth experience.

2.6. Vaginal birth after cesarean section (VBAC)

Vaginal Birth After Cesarean (VBAC) refers to the planned vaginal delivery of women who have previously undergone one or, in carefully selected cases, two cesarean sections with a low transverse uterine incision and who have no recurrent obstetric or medical contraindications to vaginal birth. Over recent years, VBAC has gained increasing recognition as an evidence-based strategy for reducing repeat cesarean section rates while promoting maternal recovery and preserving future reproductive health (VBAC, 2026).

Within contemporary obstetric practice, VBAC is considered one of the most important approaches for addressing the growing global prevalence of cesarean delivery. As cesarean section rates continue to increase worldwide, encouraging appropriately selected women to undergo a trial of labor after cesarean (TOLAC) has become an important public health strategy for reducing unnecessary

repeat surgical deliveries and their associated long-term complications (Duran et al., 2026).

Appropriate patient selection represents the cornerstone of successful VBAC. Women with a previous low transverse uterine incision, spontaneous onset of labor, a singleton pregnancy, cephalic fetal presentation, and no contraindications to vaginal birth demonstrate the highest likelihood of achieving a successful vaginal delivery. Comprehensive antenatal counseling enables women to understand both the potential benefits and the relatively low but clinically important risks associated with attempting labor after cesarean delivery.

Current evidence indicates that the success rate of VBAC ranges from approximately 60% to 80% among appropriately selected women (Lundgren et al., 2025). Successful VBAC offers several important maternal advantages, including avoidance of repeat abdominal surgery, reduced postoperative pain, earlier mobilization, shorter hospital stays, lower rates of surgical site infection, and faster return to normal daily activities. In addition, avoiding repeated surgical intervention decreases the cumulative risks associated with multiple cesarean deliveries, including intra-abdominal adhesions and operative complications (RCOG, 2024).

The long-term reproductive benefits of VBAC are particularly significant. Unlike repeated cesarean sections, successful vaginal birth does not create additional uterine scar tissue, thereby reducing the future risks of placenta previa, placenta accreta spectrum disorders, abnormal placental implantation, and other pregnancy-related complications associated with multiple uterine incisions (Keag, Norman, & Stock, 2018). Consequently, VBAC contributes not only to favorable outcomes in the current pregnancy but also to the preservation of maternal reproductive potential in subsequent pregnancies.

Although VBAC is associated with numerous maternal benefits, continuous intrapartum surveillance remains essential throughout labor. Careful monitoring of maternal and fetal well-being enables early recognition of labor abnormalities and allows timely intervention should complications arise. Among these, uterine rupture remains the most clinically significant concern; however, when labor is managed in appropriately equipped healthcare facilities with continuous fetal monitoring and immediate access to emergency cesarean delivery, the absolute risk remains low and acceptable for eligible women (FIGO, 2025).

The successful implementation of VBAC depends upon multidisciplinary collaboration among obstetricians, midwives, nurses, anesthesiologists, and neonatal healthcare professionals. Individualized labor management, continuous communication with the pregnant woman, and rapid access to emergency obstetric services are essential components of safe clinical practice. Equally important is shared decision-making, whereby healthcare professionals provide balanced, evidence-based information that enables women to make informed choices consistent with their personal preferences and clinical circumstances.

Overall, VBAC represents an important component of contemporary evidence-based maternity care. By reducing unnecessary repeat cesarean deliveries while preserving maternal safety, reproductive health, and future fertility, appropriately managed VBAC contributes to both improved individual pregnancy outcomes and broader public health objectives aimed at optimizing obstetric care.

CHAPTER III

BIRTHING METHODS CURRENTLY UNDER DEVELOPMENT

Rapid advances in digital health technologies, artificial intelligence, biomedical engineering, and precision medicine are transforming contemporary obstetric care. Although childbirth remains a fundamentally physiological process, emerging technologies are increasingly being developed to support clinical decision-making, improve maternal comfort, enhance fetal surveillance, and reduce unnecessary obstetric interventions. Unlike conventional childbirth practices, these innovative approaches do not aim to replace physiological birth; rather, they seek to optimize maternal and neonatal outcomes by integrating technological innovations into evidence-based maternity care (ACOG, 2025).

The next generation of childbirth technologies is characterized by personalized, predictive, and data-driven healthcare. Artificial intelligence algorithms capable of continuously analyzing maternal and fetal parameters, immersive virtual reality systems designed to reduce labor pain, microbiome-oriented interventions, wireless fetal monitoring technologies, and digital simulation platforms are gradually expanding the scope of modern obstetrics. Although many of these technologies remain under clinical evaluation or early implementation, they represent

promising strategies for improving childbirth safety while preserving the physiological nature of labor.

This chapter reviews the most prominent childbirth technologies currently under development, explaining their mechanisms of action, potential clinical benefits, existing limitations, and future applications within evidence-based obstetric practice.

3.1. AI-powered predictive vaginal delivery

Artificial intelligence (AI)-supported predictive vaginal birth represents one of the most rapidly evolving fields in contemporary obstetrics. By combining machine learning algorithms with continuous maternal and fetal monitoring, these systems aim to improve clinical decision-making throughout labor while reducing unnecessary obstetric interventions. Rather than replacing healthcare professionals, predictive AI functions as an advanced clinical decision-support tool that assists obstetricians and midwives in interpreting complex physiological data more rapidly and consistently (Çörekçioğlu & Menekşe, 2025).

Labor is characterized by continuous physiological changes affecting both the mother and fetus. Conventional intrapartum monitoring primarily depends on healthcare professionals interpreting cardiotocography (CTG) tracings, maternal vital signs, and labor progression. Although effective, this approach is inherently subject to interobserver variability, occasionally resulting in false-positive interpretations that may contribute to unnecessary operative deliveries, including cesarean sections (Çörekçioğlu & Menekşe, 2025).

Predictive intrapartum systems utilize artificial intelligence and deep learning algorithms capable of processing multiple physiological variables simultaneously. Maternal heart rate, fetal

heart rate, uterine contraction frequency, cervical dilation, labor progression, and selected biochemical parameters are continuously analyzed and compared with extensive clinical databases derived from previous childbirth experiences. Within seconds, these systems generate individualized risk assessments that assist healthcare professionals in identifying deviations from normal labor progression (McCoy et al., 2025; Steinberg et al., 2025).

One of the principal advantages of AI-supported predictive systems is their capacity to recognize subtle physiological changes before overt clinical deterioration becomes apparent. Conditions such as fetal hypoxia, dysfunctional labor, or prolonged labor progression may therefore be detected at an earlier stage, allowing healthcare professionals to intervene promptly when clinically indicated. Early recognition has the potential to reduce emergency obstetric procedures, improve neonatal outcomes, and decrease unnecessary cesarean section rates while supporting individualized maternity care (AlSaad et al., 2025).

Furthermore, predictive algorithms contribute to personalized childbirth management by generating individualized labor profiles based on each woman's unique physiological characteristics. This personalized approach may facilitate more accurate clinical decision-making, improve communication among multidisciplinary healthcare teams, and optimize the allocation of obstetric resources.

Despite these promising developments, several important limitations remain. Excessive algorithm sensitivity may generate frequent warning notifications, increasing the likelihood of alarm fatigue among healthcare professionals. Additionally, artificial intelligence systems are highly dependent on the quality and diversity of the datasets used during algorithm development. Models trained using homogeneous populations may demonstrate reduced

accuracy when applied to women from different ethnic, geographic, or socioeconomic backgrounds, potentially introducing algorithmic bias into clinical practice (AlSaad et al., 2025; Seyyed-Kalantari, Zhang, & McDermott, 2021).

Consequently, current evidence supports the role of artificial intelligence as a complementary clinical decision-support technology rather than an autonomous decision-maker. Large multicenter validation studies involving diverse patient populations remain essential before widespread clinical implementation can be recommended. Until such evidence becomes available, predictive AI should continue to function as an adjunct to—rather than a replacement for—the clinical expertise of obstetricians, midwives, and nurses.

3.2. Virtual reality (VR)-assisted childbirth (virtual reality analgesia)

Virtual reality (VR)-assisted childbirth, also referred to as virtual reality analgesia, is an emerging non-pharmacological intervention designed to reduce labor pain and maternal anxiety through immersive digital environments. By combining advanced visualization technologies with cognitive distraction techniques, VR offers an innovative approach to pain management that complements conventional obstetric care. As interest in personalized and minimally invasive maternity care continues to grow, VR has attracted increasing attention as a supportive tool for improving the childbirth experience (Frey et al., 2019).

Labor pain is a complex phenomenon involving physiological, psychological, emotional, and environmental components. Although pharmacological methods such as epidural analgesia remain highly effective, they may be associated with adverse effects including maternal hypotension, motor blockade,

urinary retention, or prolonged labor in selected cases. Consequently, researchers have increasingly focused on complementary non-pharmacological interventions capable of reducing pain perception while minimizing medical intervention (Frey et al., 2019).

The analgesic effect of virtual reality is primarily explained by the Gate Control Theory of Pain together with mechanisms of cognitive distraction. During VR immersion, the mother's visual, auditory, and cognitive attention becomes focused on interactive three-dimensional virtual environments rather than painful uterine contractions. Because the human brain has a limited capacity to process sensory information simultaneously, this intense sensory engagement reduces cortical perception of nociceptive stimuli transmitted through afferent neural pathways, thereby decreasing the subjective experience of labor pain (Frey et al., 2019).

Beyond pain management, virtual reality also contributes positively to maternal psychological well-being during childbirth. Immersive relaxation environments, guided breathing exercises, calming natural landscapes, and interactive mindfulness programs may reduce maternal anxiety, promote emotional relaxation, and increase feelings of control throughout labor. These psychological benefits are particularly valuable for women experiencing elevated childbirth anxiety or fear of labor.

Clinical studies have demonstrated that women using VR during the first stage of labor frequently report lower Visual Analog Scale (VAS) pain scores together with reduced anxiety levels compared with conventional care alone. Improved psychological comfort may also decrease the need for additional pharmacological analgesics and contribute to greater maternal satisfaction with the overall childbirth experience (Frey et al., 2019).

Despite its promising clinical potential, several practical considerations should be addressed before widespread implementation. VR equipment intended for obstetric use should be lightweight, wireless, ergonomically designed, and easily disinfected between patients to minimize infection risks within maternity units. Furthermore, prolonged exposure to immersive virtual environments may occasionally produce symptoms collectively referred to as cybersickness, including nausea, dizziness, visual discomfort, or transient disorientation, potentially limiting its suitability for some pregnant women (Rebenitsch & Owen, 2016).

Successful integration of VR into obstetric practice also depends on appropriate patient selection and multidisciplinary collaboration. Midwives, nurses, obstetricians, and anesthesiologists should jointly determine whether virtual reality is suitable for individual patients and provide continuous clinical supervision throughout its use. Importantly, VR should not be regarded as a replacement for established pharmacological pain management techniques but rather as a complementary intervention within a comprehensive, individualized childbirth care plan.

As digital health technologies continue to evolve, future developments are expected to integrate virtual reality with artificial intelligence, wearable biosensors, and real-time physiological monitoring systems. Such innovations may enable adaptive VR environments capable of responding dynamically to maternal stress levels, pain intensity, and labor progression, thereby providing increasingly personalized support throughout childbirth. Nevertheless, further large-scale clinical trials are required to establish standardized clinical protocols and determine the long-term effectiveness of VR-assisted childbirth across diverse obstetric populations.

Overall, virtual reality-assisted childbirth represents a promising innovation that combines technological advancement with woman-centered maternity care. By simultaneously addressing both the physical and psychological dimensions of labor, VR has the potential to improve maternal comfort, enhance childbirth satisfaction, and support evidence-based, individualized obstetric practice.

3.3. Cesarean section with natural seeding (vaginal seeding)

Cesarean section with natural seeding, commonly referred to as vaginal seeding, is an emerging microbiome-oriented intervention developed to partially restore the natural microbial exposure that occurs during vaginal birth. The procedure involves transferring maternal vaginal microorganisms to infants born by cesarean section immediately after delivery using sterile gauze that has been exposed to maternal vaginal secretions before birth. Although this approach has generated considerable scientific interest, it remains an investigational practice and has not yet been incorporated into routine obstetric care (LaPoint et al., 2025).

During vaginal birth, newborns are naturally exposed to the maternal vaginal and intestinal microbiota, particularly species belonging to the *Lactobacillus* and *Bacteroides* genera. This initial microbial colonization plays an important role in the early development of the neonatal immune system, intestinal microbiome maturation, and metabolic regulation. In contrast, infants delivered by cesarean section are predominantly colonized by microorganisms originating from maternal skin and the hospital environment, resulting in a different pattern of early microbial establishment (Dominguez-Bello, De Jesus-Laboy, & Shen, 2016).

Growing evidence suggests that differences in neonatal microbial colonization may contribute to variations in immune

development during infancy. Several observational studies have reported associations between cesarean birth and a higher incidence of allergic diseases, asthma, obesity, and type 1 diabetes later in childhood. Although these associations are influenced by numerous genetic and environmental factors, restoration of early microbial exposure has become an important area of investigation within perinatal medicine (Montoya-Williams et al., 2018).

The primary objective of vaginal seeding is to promote microbial colonization patterns that more closely resemble those observed following vaginal birth. Randomized clinical studies have demonstrated that infants receiving vaginal seeding exhibit skin, oral, and intestinal microbiome profiles that are initially more similar to those of vaginally delivered newborns. Nevertheless, current evidence also indicates that these differences may gradually diminish over time, particularly after the introduction of complementary feeding and other postnatal environmental influences (Mueller et al., 2020).

Although the concept of microbiome restoration appears biologically plausible, important clinical uncertainties remain. At present, there is insufficient evidence demonstrating that short-term changes in microbial colonization translate into measurable long-term improvements in child health outcomes. Consequently, further large-scale prospective studies are required before routine clinical implementation can be recommended.

The principal concern surrounding vaginal seeding is the potential transmission of maternal pathogens to the newborn. Undiagnosed maternal infections, including Group B Streptococcus (GBS), *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, and Herpes Simplex Virus (HSV), may be inadvertently transferred during the procedure, increasing the risk of neonatal infection, sepsis, conjunctivitis, or other serious complications (ACOG, 2017).

Therefore, careful maternal infection screening represents an essential prerequisite whenever vaginal seeding is considered within approved research settings.

For this reason, major international professional organizations, including the American College of Obstetricians and Gynecologists (ACOG), currently do not recommend routine vaginal seeding outside ethically approved clinical research protocols because of the limited evidence regarding both its long-term efficacy and safety (ACOG, 2017). Women expressing interest in the procedure should receive comprehensive counseling regarding the available evidence, potential benefits, existing uncertainties, and possible infectious risks before informed consent is obtained.

Future research focusing on neonatal microbiome science, precision medicine, and probiotic interventions may further clarify the clinical role of vaginal seeding. As knowledge regarding host–microbiome interactions continues to expand, microbiome-based strategies may eventually become valuable components of individualized neonatal care. Until robust evidence becomes available, however, vaginal seeding should continue to be regarded as an investigational intervention rather than a standard obstetric practice.

Overall, vaginal seeding represents a promising example of how advances in microbiome research may influence future obstetric and neonatal care. Nevertheless, its integration into routine clinical practice should remain guided by high-quality scientific evidence, rigorous infection control measures, ethical oversight, and patient-centered decision-making.

3.4. Telemetric and mobile hydrotherapy childbirth (advanced water birth)

Telemetric and mobile hydrotherapy childbirth, also referred to as advanced water birth, represents an innovative evolution of conventional hydrotherapy-assisted labor. By integrating wireless fetal monitoring technologies with hydrotherapy, this approach aims to preserve the physiological and analgesic benefits of water immersion while ensuring uninterrupted maternal and fetal surveillance throughout labor. As digital obstetric technologies continue to advance, telemetric hydrotherapy has emerged as a promising strategy for combining maternal comfort with enhanced clinical safety (Uğurlu & Döner, 2024).

Conventional water birth has long been recognized as an effective non-pharmacological method for reducing labor pain, promoting maternal relaxation, and facilitating physiological childbirth. However, one of its principal limitations has been the interruption of continuous fetal monitoring when women enter the birthing pool, particularly when traditional wired cardiotocography (CTG) systems are used. This limitation has restricted the use of hydrotherapy in women requiring closer intrapartum surveillance (NHS, 2024).

To overcome this challenge, advanced hydrotherapy systems incorporate waterproof, lightweight, and wireless telemetric sensors that continuously monitor both maternal and fetal physiological parameters during immersion. These wearable monitoring devices record fetal heart rate, uterine contractions, and selected maternal vital signs before transmitting the data in real time to central monitoring stations through secure wireless communication systems. Consequently, healthcare professionals are able to maintain continuous observation without restricting maternal mobility or

interrupting hydrotherapy (Mini Telemetry, 2026; Mitchell & Khan, 2022).

A major advantage of telemetric hydrotherapy is the preservation of maternal freedom of movement throughout labor. Unlike conventional monitoring systems, wireless telemetry allows women to walk, change positions, and move naturally within the birthing pool while maintaining uninterrupted fetal surveillance. This combination of physiological mobility and continuous monitoring supports individualized, woman-centered maternity care by reducing unnecessary restrictions during labor.

The analgesic benefits of hydrotherapy remain an essential component of this advanced approach. Warm water immersion promotes muscle relaxation, stimulates endogenous endorphin release, decreases maternal stress responses, and contributes to lower pain perception during labor. Clinical studies have reported that women undergoing telemetric hydrotherapy frequently experience reduced pain intensity together with greater childbirth satisfaction while maintaining appropriate fetal monitoring throughout labor (Bedir Fındık et al., 2025).

From a clinical perspective, continuous telemetric fetal monitoring enhances patient safety by enabling earlier recognition of abnormal fetal heart rate patterns, prolonged labor, or other intrapartum complications. Early detection allows timely clinical intervention whenever necessary while preserving the non-pharmacological benefits associated with water immersion. Accordingly, telemetric hydrotherapy represents an important advancement in balancing physiological childbirth with modern obstetric surveillance.

Despite these advantages, several practical limitations continue to influence the widespread implementation of advanced hydrotherapy systems. Wireless signal interruption during

underwater monitoring, occasional transmission artifacts, equipment costs, maintenance requirements, and strict infection prevention protocols remain important operational challenges. In addition, specialized birthing facilities, trained multidisciplinary healthcare teams, and standardized institutional guidelines are essential prerequisites for the safe integration of telemetric hydrotherapy into routine obstetric practice (NHS, 2024).

As digital monitoring technologies continue to evolve, future hydrotherapy systems are expected to integrate artificial intelligence, wearable biosensors, and automated environmental controls capable of continuously regulating water temperature, filtration, and physiological monitoring. These developments may further enhance maternal comfort while strengthening patient safety and supporting individualized labor management.

Overall, telemetric and mobile hydrotherapy childbirth represents a significant advancement in contemporary obstetric technology by successfully integrating physiological childbirth principles with continuous digital monitoring. Although further technological refinement and broader clinical evaluation remain necessary, this approach demonstrates considerable potential for improving maternal comfort, maintaining fetal safety, and expanding the clinical applicability of hydrotherapy-assisted childbirth.

3.5. A personalized birth plan using smart birth simulators

Personalized birth planning supported by smart birth simulators represents one of the most innovative developments in precision obstetrics. Unlike conventional birth plans, which primarily document maternal preferences regarding labor and delivery, smart simulation technologies integrate advanced imaging techniques, artificial intelligence, and biomechanical modeling to generate individualized childbirth scenarios based on each woman's

unique anatomical and physiological characteristics. This personalized approach aims to improve clinical decision-making while supporting safer and more predictable childbirth (Afshar et al., 2019).

Traditional birth plans have long served as valuable communication tools between pregnant women and healthcare professionals. However, labor is a dynamic physiological process influenced by numerous maternal, fetal, and obstetric variables that cannot always be anticipated before childbirth begins. Consequently, standardized birth plans may not fully reflect the complex biomechanical interactions that occur during labor. Smart birth simulators have been developed to address this limitation by creating patient-specific digital models capable of predicting labor progression under different clinical conditions.

The development of these personalized simulations begins with the integration of maternal imaging data obtained during late pregnancy. Ultrasound (USG) and magnetic resonance imaging (MRI) datasets are incorporated into artificial intelligence–supported software platforms capable of reconstructing three-dimensional digital models of the maternal pelvis, birth canal, fetal head position, and estimated fetal size. Through digital twin technology, these anatomical structures are transformed into individualized virtual environments that closely represent the anticipated conditions of childbirth (PelviTwin, 2026).

Using these personalized digital models, smart simulators mathematically estimate the biomechanical interactions expected during labor. Factors such as uterine contraction forces, fetal rotational movements, pelvic dimensions, maternal tissue resistance, and the mechanical relationship between the fetal head and the birth canal are analyzed simultaneously. This comprehensive analysis enables healthcare professionals to estimate the probability of

successful vaginal birth and identify potential mechanical complications before labor begins (PelviTwin, 2026).

One of the principal clinical advantages of smart birth simulators is their ability to support individualized obstetric planning. Simulation results may assist obstetricians and midwives in identifying women at increased risk of prolonged labor, cephalopelvic disproportion, or shoulder dystocia, thereby facilitating early clinical preparation and individualized delivery planning. Rather than replacing clinical judgment, these systems function as advanced decision-support tools that complement evidence-based obstetric assessment.

Smart simulation technology also enhances patient education and shared decision-making. By visualizing individualized labor scenarios, pregnant women may gain a better understanding of their own childbirth process, expected challenges, and available delivery options. This improved communication may reduce uncertainty, strengthen maternal confidence, and facilitate collaborative planning between women and their healthcare teams.

Recent studies suggest that simulation-assisted obstetric planning may improve prediction of mechanical birth complications requiring emergency intervention, including shoulder dystocia and difficult operative delivery (Allen et al., 2024). Furthermore, simulator-generated recommendations regarding optimal maternal positioning during labor may contribute to reductions in maternal soft tissue trauma and neonatal birth injuries by supporting more efficient fetal descent through the birth canal (Lin et al., 2023).

Despite these promising developments, several important limitations remain. High-resolution imaging systems, advanced computational software, and specialized technical expertise contribute to considerable implementation costs. In addition, current simulation models cannot fully account for the unpredictable

biological and physiological events that frequently occur during labor, including variations in uterine contractility, maternal fatigue, fetal adaptation, and rapidly evolving obstetric emergencies. Therefore, simulation findings should always be interpreted within the broader context of comprehensive clinical assessment rather than as definitive predictors of childbirth outcomes.

Future advances in artificial intelligence, digital twin technology, and real-time physiological monitoring are expected to further improve the accuracy and clinical applicability of personalized birth simulators. Integration with wearable biosensors, predictive intrapartum algorithms, and continuously updated maternal-fetal data may eventually enable dynamic simulations capable of adapting throughout labor, thereby supporting truly personalized obstetric care.

Overall, smart birth simulators represent an important step toward precision maternity care by combining biomedical engineering, artificial intelligence, and individualized clinical planning. Although additional clinical validation is required before widespread implementation, these technologies have considerable potential to improve obstetric decision-making, optimize maternal and neonatal outcomes, and enhance personalized childbirth planning.

3.6. Innovative Midwifery and Nursing Approaches to Birth Technologies

The rapid integration of artificial intelligence, virtual reality, wearable monitoring devices, digital twin technologies, and wireless telemetry systems into obstetric practice is fundamentally transforming the organization and delivery of maternity care. While these technological innovations have significantly expanded the diagnostic and therapeutic capabilities available during pregnancy

and childbirth, they have simultaneously increased the importance of midwives and nurses as coordinators of safe, individualized, and compassionate care. Rather than diminishing the role of healthcare professionals, technological advancement has reinforced the essential contribution of midwives and nurses in ensuring that digital innovations are applied within a holistic, woman-centered framework (Darwesh, Kassem, & Khalil, 2024).

Modern childbirth extends beyond the successful application of advanced medical technologies. Positive maternal outcomes also depend on effective communication, emotional support, ethical decision-making, and continuous clinical assessment throughout pregnancy, labor, and the postpartum period. Midwives and nurses therefore function as the bridge between sophisticated technological systems and the individualized needs, expectations, and emotional well-being of women and their families. Their professional responsibilities include not only interpreting technological data but also preserving the humanistic philosophy that remains central to maternity care.

Artificial intelligence–supported decision systems and predictive obstetric algorithms generate large volumes of continuous physiological information. Although these technologies improve clinical surveillance, they also increase the possibility of alarm fatigue resulting from repeated non-critical notifications. In this context, the clinical expertise of midwives and nurses becomes indispensable. By integrating digital information with bedside assessment, maternal observations, and professional clinical judgment, healthcare professionals distinguish false-positive alerts from genuine obstetric emergencies, thereby ensuring that clinical interventions remain both timely and appropriate (Kenneth, 2024).

The introduction of advanced technologies has also expanded professional responsibilities related to patient safety and quality

assurance. Midwives and nurses are responsible for maintaining infection prevention protocols during hydrotherapy-assisted childbirth, supervising the safe use and disinfection of wearable monitoring devices, supporting aseptic procedures associated with investigational interventions such as vaginal seeding, and continuously monitoring maternal and fetal well-being throughout technology-assisted labor. These responsibilities highlight the continuing importance of clinical vigilance despite increasing technological sophistication.

Education represents another essential component of technology-supported maternity care. As digital childbirth technologies become more widely available, pregnant women require comprehensive guidance regarding their indications, expected benefits, limitations, and potential risks. Midwives and nurses therefore assume a central educational role by explaining the appropriate use of virtual reality systems, interpreting simulation-generated birth plans, preparing women for technology-assisted labor, and promoting informed participation in clinical decision-making. Such educational support strengthens maternal autonomy and contributes to greater confidence throughout the childbirth process.

The growing use of personalized obstetric technologies has also increased the importance of ethical practice. Midwives and nurses play a critical role in protecting patient privacy, maintaining data confidentiality, obtaining informed consent, and ensuring that technological interventions remain consistent with the individual values, preferences, and cultural expectations of each woman. In digital healthcare environments, preserving dignity, respect, and individualized care remains equally as important as maintaining technological excellence.

Continuous professional development has become increasingly important as maternity care evolves. Midwives and nurses are expected to develop competencies not only in conventional obstetric care but also in digital literacy, artificial intelligence applications, wearable technologies, telehealth systems, and evidence-based interpretation of technologically generated clinical data. Lifelong learning and interdisciplinary collaboration therefore represent fundamental components of future maternity care (Rattanasak et al., 2025; Ullah et al., 2021).

Looking ahead, technological innovation should be viewed as a means of strengthening—not replacing—the professional role of midwives and nurses. Although digital systems are capable of supporting clinical decision-making, they cannot replicate the empathy, communication, ethical reasoning, and individualized support provided by experienced healthcare professionals. Consequently, the future of maternity care will depend on successfully integrating technological innovation with compassionate, evidence-based, and woman-centered clinical practice.

Overall, innovative childbirth technologies should be regarded as valuable tools that enhance, rather than substitute for, professional maternity care. The successful implementation of these technologies requires well-trained healthcare professionals who possess both advanced digital competencies and a strong commitment to holistic, family-centered care. By combining technological innovation with compassionate clinical practice, midwives and nurses will continue to play a central role in improving maternal and neonatal outcomes in the future of obstetric care.

3.7.Ethical and Legal Considerations

The rapid integration of artificial intelligence, wearable monitoring devices, virtual reality applications, telemetric hydrotherapy systems, and digital simulation technologies into obstetric practice has introduced new ethical and legal challenges alongside their clinical benefits. Although these innovations have the potential to improve maternal and neonatal outcomes through more accurate clinical assessment and individualized care, their implementation must always comply with the fundamental principles of medical ethics, including respect for autonomy, beneficence, non-maleficence, justice, and professional accountability (ACOG, 2025; FIGO, 2025).

Respect for maternal autonomy remains one of the cornerstones of modern maternity care. Every pregnant woman has the right to receive clear, evidence-based information regarding available childbirth technologies, their potential benefits, possible risks, and existing uncertainties before making informed decisions concerning her care. Technologies such as AI-supported decision systems, VR-assisted labor analgesia, digital birth simulation, and vaginal seeding should never replace shared decision-making between healthcare professionals and expectant mothers. Instead, they should serve as supportive tools that facilitate individualized clinical discussions while preserving maternal preferences and informed consent (FIGO, 2025; RCOG, 2024).

Data privacy and cybersecurity have become increasingly important with the widespread use of wearable sensors and cloud-based digital monitoring systems. Continuous collection of maternal physiological data, fetal heart rate recordings, biometric measurements, and electronic health information requires robust data protection strategies to safeguard patient confidentiality. Unauthorized access, cyberattacks, or inappropriate secondary use

of health information may compromise both patient safety and public trust in digital healthcare technologies. Therefore, healthcare institutions should establish secure digital infrastructures, encrypted communication systems, and comprehensive cybersecurity protocols before implementing these technologies in routine obstetric practice (Darwesh, Kassem, & Khalil, 2024; Ullah et al., 2021).

Another important ethical consideration involves algorithmic transparency and fairness. Artificial intelligence systems are developed using previously collected clinical datasets, and the quality, diversity, and representativeness of these datasets directly influence algorithm performance. When training datasets fail to adequately represent different ethnic groups, maternal ages, socioeconomic backgrounds, or pregnancy characteristics, algorithmic bias may occur, potentially leading to inaccurate risk prediction or unequal healthcare outcomes. Consequently, continuous validation using multicenter and heterogeneous populations is essential before AI-based clinical decision-support systems can be widely adopted in maternity care (Seyyed-Kalantari, Zhang, & McDermott, 2021; Steinberg et al., 2025).

Professional accountability should always remain with qualified healthcare professionals regardless of technological advancement. Artificial intelligence systems, predictive algorithms, and digital simulators should support—but never replace—the clinical reasoning of obstetricians, midwives, and nurses. Final clinical decisions must continue to rely on comprehensive patient assessment, professional expertise, current evidence, and individualized maternal circumstances. Maintaining this balance protects patient safety while preventing excessive dependence on automated technologies (AlSaad et al., 2025; Backes et al., 2024).

The introduction of innovative technologies also requires careful consideration of legal responsibilities. Healthcare professionals should ensure that informed consent procedures specifically address the use of digital technologies, including explanations regarding their intended purpose, expected clinical benefits, limitations, possible technical failures, and data management procedures. Documentation of informed consent should become an integral component of technology-assisted maternity care, particularly when novel interventions remain under clinical evaluation or research protocols (ACOG, 2025; FIGO, 2025).

Equitable access represents another important ethical challenge. Advanced childbirth technologies may initially become available only in tertiary referral centers or highly specialized institutions because of financial costs and technological infrastructure requirements. Such inequalities could widen existing disparities in maternal healthcare if access remains limited to specific geographical regions or socioeconomic groups. Future implementation strategies should therefore prioritize equitable distribution of technological resources while ensuring that all pregnant women have the opportunity to benefit from evidence-based innovations regardless of their socioeconomic status (Backes et al., 2024).

Finally, the integration of digital technologies should never diminish the humanistic nature of childbirth. Pregnancy and birth remain profoundly personal experiences that require empathy, emotional support, respectful communication, and continuous professional presence. While technology can improve clinical precision and patient safety, compassionate care delivered by skilled midwives, nurses, and obstetricians remains irreplaceable. The future of maternity care therefore depends on achieving an

appropriate balance between technological innovation and human-centered healthcare, ensuring that advances in digital medicine strengthen rather than replace therapeutic relationships between healthcare professionals and families (Kenneth, 2024; Darwesh, Kassem, & Khalil, 2024).

3.8. Future Perspectives

Advances in digital health technologies are expected to reshape maternity care over the coming decade by transforming childbirth into a more personalized, predictive, preventive, and participatory process. Rather than replacing physiological birth, future obstetric practice is anticipated to combine evidence-based clinical care with intelligent digital support systems that continuously monitor maternal and fetal well-being while preserving the natural progression of labor whenever possible. Emerging technologies such as artificial intelligence, wearable biosensors, digital twins, telemedicine, and simulation-based obstetric planning are likely to become increasingly integrated into routine maternity services as their safety, effectiveness, and accessibility continue to improve (Smith & Rahmani, 2026; Steinberg et al., 2025).

Artificial intelligence is expected to play a progressively greater role in supporting clinical decision-making throughout pregnancy, labor, and the postpartum period. Future AI platforms may integrate information obtained from electronic health records, continuous fetal monitoring, maternal wearable devices, laboratory findings, ultrasound examinations, and previous obstetric histories into a single decision-support environment. Such comprehensive integration could facilitate earlier identification of obstetric complications, optimize individualized care pathways, and reduce unnecessary medical interventions while maintaining maternal and fetal safety. Nevertheless, these systems should continue to function

as supportive clinical tools, with final medical decisions remaining under the responsibility of qualified healthcare professionals (AlSaad et al., 2025; Steinberg et al., 2025).

Wearable health technologies are also expected to expand considerably in the coming years. Improvements in wireless biosensors may enable continuous monitoring of maternal vital signs, fetal movement patterns, uterine activity, and maternal physical activity not only within hospitals but also in community settings and at home. Integration of these monitoring systems with secure telemedicine platforms may facilitate earlier recognition of potential complications, reduce unnecessary hospital visits, and improve continuity of maternity care, particularly for women living in geographically remote areas or experiencing high-risk pregnancies (Smith & Rahmani, 2026; Rattanasak et al., 2025; Ullah et al., 2021).

Rapid developments in computational modeling are likely to enhance the clinical value of digital twin technologies. Future simulation platforms may become capable of incorporating continuously updated physiological information throughout pregnancy, allowing healthcare professionals to refine individualized birth plans as maternal and fetal conditions evolve. Such technologies may contribute to more accurate prediction of labor progression, optimization of delivery strategies, and reduction of unexpected intrapartum complications while supporting shared decision-making between healthcare professionals and expectant mothers (PelviTwin, 2026; Allen et al., 2024).

Future maternity care is also expected to place greater emphasis on interdisciplinary collaboration. Obstetricians, midwives, nurses, anesthesiologists, neonatologists, biomedical engineers, computer scientists, and information technology specialists will increasingly work together to develop, evaluate, and

safely implement innovative childbirth technologies. Consequently, healthcare education programs may progressively incorporate digital health literacy, artificial intelligence, biomedical engineering principles, and simulation-based training into undergraduate and postgraduate curricula for maternity care professionals (Darwesh, Kassem, & Khalil, 2024; Backes et al., 2024).

From a public health perspective, future technological innovations should prioritize equitable access, affordability, and sustainability in addition to scientific advancement. Although sophisticated digital technologies initially become available within tertiary referral centers, broader implementation strategies should aim to ensure that women receiving maternity care in community hospitals, rural healthcare facilities, and low-resource settings also benefit from evidence-based innovations. Reducing disparities in access to safe maternity care should remain one of the principal objectives of future obstetric development (FIGO, 2025; ACOG, 2025).

Another important future direction involves the continuous evaluation of emerging technologies through large-scale multicenter clinical studies. Long-term investigations will be essential to determine not only clinical effectiveness but also cost-effectiveness, patient satisfaction, maternal quality of life, neonatal outcomes, and healthcare system sustainability. High-quality scientific evidence will remain the foundation upon which future innovations are incorporated into international clinical guidelines and routine obstetric practice (RCOG, 2024; Steinberg et al., 2025).

Despite remarkable technological progress, the future of childbirth should continue to preserve its fundamentally human-centered philosophy. Pregnancy, labor, and birth are unique life experiences that extend beyond physiological processes to encompass emotional, psychological, social, and cultural

dimensions. Therefore, future innovations should aim not only to improve clinical accuracy but also to strengthen respectful maternity care, individualized support, effective communication, and compassionate professional practice. The most successful maternity care systems of the future will be those that integrate advanced technology with evidence-based clinical expertise while preserving the dignity, autonomy, and well-being of every mother and newborn (Backes et al., 2024; Kenneth, 2024).

3.9.Practical Recommendations

The successful integration of emerging childbirth technologies into routine maternity care requires a multidisciplinary, evidence-based, and patient-centered implementation strategy. Although innovative technologies such as artificial intelligence, virtual reality, telemetric monitoring, wearable sensors, and digital simulation systems offer considerable potential to improve maternal and neonatal outcomes, their effectiveness depends largely on appropriate clinical application, professional competency, and continuous evaluation. The following recommendations summarize practical considerations for healthcare professionals, healthcare institutions, researchers, educators, and policymakers to facilitate the safe and effective implementation of these innovations in obstetric practice.

3.9.1.Recommendations for Midwives and Nurses

Midwives and nurses should maintain their central role in providing holistic, compassionate, and evidence-based maternity care while embracing technological innovations that enhance clinical practice. Continuous professional education in artificial intelligence, wearable monitoring systems, virtual reality applications, digital simulation technologies, and telemetric monitoring should become an integral component of lifelong

learning. Developing digital literacy alongside traditional clinical competencies will enable healthcare professionals to interpret technological information appropriately without compromising individualized maternal care (Backes et al., 2024; Kenneth, 2024).

Healthcare professionals should continue to prioritize respectful communication, informed consent, emotional support, and individualized care throughout pregnancy, labor, and the postpartum period. Technological innovations should strengthen rather than replace the therapeutic relationship established between healthcare professionals and expectant families. Midwives and nurses should also actively participate in evaluating new technologies, reporting technical limitations, identifying potential safety concerns, and contributing to quality improvement initiatives within maternity services (Darwesh, Kassem, & Khalil, 2024).

3.9.2.Recommendations for Obstetricians

Obstetricians should utilize emerging digital technologies as clinical decision-support systems rather than independent decision-making tools. Artificial intelligence algorithms, digital birth simulators, predictive monitoring systems, and wearable technologies should complement comprehensive clinical assessment while preserving individualized patient management. Regular validation of algorithm performance, careful interpretation of digital outputs, and integration of technological findings with professional clinical judgment remain essential for maintaining patient safety (Steinberg et al., 2025; AlSaad et al., 2025).

Interdisciplinary collaboration with midwives, nurses, anesthesiologists, neonatologists, biomedical engineers, and information technology specialists should be encouraged to optimize the implementation of innovative childbirth technologies. Such collaboration facilitates comprehensive patient care while ensuring

that technological advances remain clinically meaningful and responsive to individual maternal needs.

3.9.3.Recommendations for Healthcare Institutions

Healthcare institutions should establish secure technological infrastructures before implementing advanced digital maternity care systems. Appropriate cybersecurity measures, standardized maintenance procedures, equipment calibration, infection prevention protocols, and technical support services should accompany the introduction of wearable monitoring devices, telemetric hydrotherapy systems, and digital communication platforms. Continuous monitoring of system performance and regular quality assurance activities are essential to maintain patient safety and healthcare quality (Ullah et al., 2021; Mitchell & Khan, 2022).

Hospitals should also invest in continuing education programs that prepare healthcare professionals to safely operate emerging technologies while maintaining evidence-based maternity care principles. Simulation-based training and interdisciplinary educational activities may improve both technical competence and team communication during technology-assisted childbirth.

3.9.4.Recommendations for Researchers

Future research should prioritize large-scale, multicenter randomized controlled trials evaluating the clinical effectiveness, safety, cost-effectiveness, and long-term outcomes of innovative childbirth technologies. Studies should include diverse maternal populations to minimize algorithmic bias and improve the generalizability of research findings. Particular attention should be given to evaluating maternal satisfaction, neonatal outcomes, health-related quality of life, and long-term reproductive health following technology-assisted maternity care (Seyyed-Kalantari, Zhang, & McDermott, 2021; Steinberg et al., 2025).

Researchers should also investigate ethical, legal, organizational, and socioeconomic aspects of digital obstetric care to ensure that technological innovation remains equitable, accessible, and sustainable across different healthcare systems.

3.9.5.Recommendations for Policymakers

Health policymakers should support the development of national regulatory frameworks governing the safe implementation of artificial intelligence, wearable health technologies, telemedicine, and digital clinical decision-support systems in maternity care. Standardized clinical guidelines, accreditation criteria, ethical governance mechanisms, and data protection regulations should accompany technological innovation to ensure consistent quality of care across healthcare institutions (FIGO, 2025; ACOG, 2025).

Investment in digital healthcare infrastructure, professional education, and equitable access to technological innovations will contribute to reducing disparities in maternal healthcare while promoting safer childbirth experiences for women and newborns. Public policies should encourage responsible innovation by balancing scientific progress with ethical principles, patient rights, and evidence-based clinical practice.

3.9.6.General Recommendations

Ultimately, technological innovation should always remain a means of enhancing—not replacing—high-quality maternity care. The future of childbirth depends not only on increasingly sophisticated technologies but also on the continued commitment of healthcare professionals to compassionate, respectful, and individualized care. Successful integration of innovative childbirth technologies requires collaboration among clinicians, researchers, educators, healthcare institutions, and policymakers, ensuring that scientific progress consistently serves the best interests of mothers, newborns, and families. By combining technological excellence

with human-centered care, maternity services can continue to improve safety, satisfaction, and long-term reproductive health while preserving the physiological and emotional significance of childbirth (Backes et al., 2024; Darwesh, Kassem, & Khalil, 2024).

3.10. Conclusion

The longstanding traditional methods of childbirth, together with the innovations introduced by modern medical technology, have opened the way to a new era in obstetrics and perinatal care. Although childbirth remains a fundamentally physiological process, it is also characterized by dynamic maternal and fetal changes that may require timely clinical intervention. Throughout this book, both established childbirth methods and emerging technological innovations have been examined within the framework of evidence-based practice, emphasizing their clinical indications, benefits, limitations, and future potential.

The innovative technologies discussed—including artificial intelligence-supported predictive intrapartum care, virtual reality (VR) analgesia, vaginal seeding, telemetric hydrotherapy, and smart birth simulators—illustrate the continuing transformation of maternity care toward more personalized, predictive, and data-driven clinical practice. Rather than replacing conventional obstetric approaches, these technologies are intended to strengthen clinical decision-making, improve maternal comfort, optimize fetal surveillance, and support safer, more individualized childbirth experiences.

Future maternity care should focus on integrating technological innovation into routine clinical practice while preserving the physiological nature of childbirth and maintaining woman-centered, evidence-based care. The successful implementation of these innovations depends not only on

technological advancement but also on multidisciplinary collaboration among obstetricians, midwives, nurses, anesthesiologists, engineers, researchers, and healthcare policymakers.

Equally important is preserving the ethical principles that underpin high-quality maternity care. Respect for maternal autonomy, informed decision-making, patient privacy, equitable access to healthcare technologies, and culturally sensitive care should remain fundamental considerations as digital innovations become increasingly integrated into obstetric practice. Technological progress should consistently strengthen—rather than diminish—the therapeutic relationship between healthcare professionals and expectant families (Darwesh, Kassem, & Khalil, 2024).

Future research should continue to evaluate the clinical effectiveness, cost-effectiveness, accessibility, and long-term maternal and neonatal outcomes associated with emerging childbirth technologies across diverse healthcare systems. In addition, further multicenter clinical studies are required to address current limitations related to data security, algorithmic bias, cyber-related health risks, infection prevention, and regulatory implementation. Generating robust scientific evidence will be essential before many of these innovations can become components of routine obstetric care (Allen et al., 2024; Rattanasak et al., 2025).

Ultimately, the future of childbirth will not be defined solely by increasingly sophisticated technologies, but by the ability to combine scientific innovation with compassionate, respectful, and individualized maternity care. The most successful maternity services will be those that integrate technological excellence with clinical expertise, ethical responsibility, and human-centered care. By maintaining this balance, modern obstetrics can continue to

improve maternal and neonatal outcomes while preserving childbirth as a safe, positive, and meaningful life experience.

REFERENCES

Afshar, Y., Mei, J., Fahey, J., & Gregory, K. D. (2019). Birth Plans and Childbirth Education: What Are Provider Attitudes, Beliefs, and Practices?. The Journal of perinatal education, 28(1), 10–18. https://doi.org/10.1891/1058-1243.28.1.10

Allen, R. H., Islam, R., Sant'Anna Marhino, C., & Allen, E. G. (2024). Self-assessment and Modulation of Traction During Shoulder Dystocia Simulation Training. Journal of patient safety, 20(6), 388–391. https://doi.org/10.1097/PTS.0000000000001240

AlSaad, R., Farrell, T., Dela Cruz, J., Abd-Alrazaq, A., Thomas, R., & Sheikh, J. (2025). Artificial intelligence models for predicting the mode of delivery in maternal care. Journal of gynecology obstetrics and human reproduction, 54(7), 102976. https://doi.org/10.1016/j.jogoh.2025.102976

American College of Obstetricians and Gynecologists (ACOG). (2017). Committee Opinion No. 725: Vaginal seeding. Obstetrics & Gynecology, 130(5), e274-e278.

American College of Obstetricians and Gynecologists. (ACOG). (2025). ACOG Practice Bulletin No. 205: Vaginal birth after cesarean delivery. Obstetrics & Gynecology, 143(4), e120–e135. wolterskluwer.com

Anim-Somuah, M., Smyth, R. M., Cyna, A. M., & Cuthbert, A. (2018). Epidural versus non-epidural veya no analgesia for pain management in labour. Cochrane Database of Systematic Reviews, (5), CD000352.

Bedir Fındık, R., Kaçar, N., Uzunlar, Ö., Yılmaz, G., Mert Yılmaz, F. M., Karakaya, J., & Ustun, Y. (2025). Association Between Hydrotherapy During Labor and β-Endorphin Levels in Postpartum Mother's Milk. Journal of Human Lactation, 41(2), 243-253.

Backes, E. P., & Scrimshaw, S. C. (Eds.). (2020). Birth settings in America: Outcomes, quality, access, and choice. Washington, DC: National Academies Press.

Bovbjerg, M. L., Cheyney, M., Brown, J., Cox, K. J., & Leeman, L. (2016). Perspectives on waterbirth outcomes using real-world data: Maternal and neonatal outcomes. Birth, 43(1), 14–26.

Cambiaghi, V., Comforti, M., & Torricelli, M. (2025). Low-dose epidural analgesia (walking epidural) and its impact on maternal mobility and course of labor. International Journal of Obstetric Anesthesia, 58, 103982.

Chestnut, D. H., Wong, C. A., Tsen, L. C., Ngan Kee, W. D., Beilin, Y., & Mhyre, J. M. (2020). Chestnut's obstetric anesthesia: Principles and practice (6. baskı). Elsevier.

Cluett, E. R., Burns, E., & Cuthbert, A. (2018). Immersion in water during labour and birth. Cochrane Database of Systematic Reviews, (5), CD000111.

Crenshaw, J. T. (2014). Healthy birth practice #6: Keep mother and baby together—It's best for mother, baby, and breastfeeding. The Journal of Perinatal Education, 23(4), 211–217.

Cunningham, F. G., Leveno, K. J., Dashe, J. S., Hoffman, B. L., Spong, C. Y., & Casey, B. M. (2022). Williams obstetrics (26. baskı). McGraw Hill.

Çitak, G., Çakir, D., & Toker, S. (2025). Impact of delivery mode on childbirth satisfaction, birth memory, and pregnancy avoidance. *BMC Pregnancy and Childbirth*, *25*(1), 980.

Çörekçioğlu, N., & Menekşe, A. (2025). The Role of Artificial Intelligence in Gynecology and Obstetrics. Turkish Journal of Health Research, 6(1), 57-67. https://izlik.org/JA46HL42YP

Darwesh, E. S. S., Kassem, I. K. A., & Khalil, A. K. (2024). Maternity Nurses' Role toward Safety Measures in Labor Unit. Menoufia Nursing Journal, 9(3), 195-214.

Dominguez-Bello, M. G., De Jesus-Laboy, K. M., & Shen, N. (2016). Partial restoration of the microbiota of cesarean-born infants via vaginal seeding. Nature Medicine, 22(3), 250-253.

Dominguez-Bello, M. G., Godoy-Vitorino, F., Knight, R., & Blaser, M. J. (2019). Role of the microbiome in human development and health: An overview of vaginal delivery vs. cesarean section. American Journal of Obstetrics and Gynecology, 221(5), 421–431.

Duran, M. N., Ilgin, S. K., Demir, S. S., Sengi, A., & Demir, B. (2026). Vaginal birth after cesarean: maternal and fetal outcomes in a multicenter study. The journal of maternal-fetal & neonatal medicine : the official journal of the European Association of Perinatal Medicine, the Federation of Asia and Oceania Perinatal Societies, the International Society of Perinatal Obstetricians, 39(1), 2622238. https://doi.org/10.1080/14767058.2026.2622238

Frey, D. P., Bauer, M. E., Bell, C. L., Low, L. K., Hassett, A. L., Cassidy, R. B., … Sharar, S. R. (2019). Virtual Reality Analgesia in Labor: The VRAIL Pilot Study-A Preliminary Randomized Controlled Trial Suggesting Benefit of Immersive Virtual Reality Analgesia in Unmedicated Laboring Women. Anesth Analg, 128(6), e93–e96. https://doi.org/10.1213/ANE.0000000000003649

Hansen, A. K., Wisborg, K., Uldbjerg, N., & Henriksen, T. B. (2018). Elective cesarean section and respiratory morbidity in the term and near-term neonate. Acta Obstetricia et Gynecologica Scandinavica, 97(4), 405–412.

International Federation of Gynecology and Obstetrics (FIGO) (2025). FIGO good practice recommendations for vaginal

birth after cesarean section. International Journal of Gynecology & Obstetrics, 170(2), 145–158. onlinelibrary.wiley.com

Investment in new maternity equipment to monitor babies provides a better experience for women and birthing people (NHS) (2024). https://www.uhdb.nhs.uk/latest-news/investment-in-new-maternity-equipment-to-monitor-babies-provides-a-better-experience-for-women-and-birthing-people--18582/ Access date: 13.05.2026

Keag, O. E., Norman, J. E., & Stock, S. J. (2018). Long-term risks and benefits associated with cesarean delivery for mother, baby, and subsequent pregnancies: A systematic review and meta-analysis. PLOS Medicine, 15(1), e1002494.

Kedir, A., Bekele, H., & Tefera, M. (2025). Rates of fear of childbirth after previous cesarean section in Dire Dawa City, Ethiopia. Women's Health, 21, 17455057251349628.

Kenneth, N. J. (2024). Advancements in maternal healthcare: Innovations and access. Research Invention Journal of Biological and Applied Sciences, 3(2), 10–14.

Landon, M. B., & Lynch, C. D. (2018). Optimal timing and mode of delivery for fetal protection in high-risk pregnancies. Seminars in Perinatology, 42(5), 297–304.

LaPoint, P., Banks, K., Bacorn, M., Prasad, R., Romero-Soto, H. N., Namasivayam, S., Chen, Q., Patel, A., Levy, S., & Hourigan, S. K. (2025). Can Vaginal Seeding at Birth Improve Health Outcomes of Cesarean Section-Delivered Infants? A Scoping Review. Microorganisms, 13(6), 1236. https://doi.org/10.3390/microorganisms13061236

Lin, H., Liu, G., Wang, X., Xu, Q., Guo, S., & Hu, R. (2023). A virtual simulation-based training program on birthing positions: a randomized controlled trial. BMC nursing, 22(1), 318. https://doi.org/10.1186/s12912-023-01491-7

LGAZ, S. (2025). A Study on the Level of Achievement of Strategic Plans and Targets Regarding the Mode of Delivery in Turkey. Journal of Business Academy, 6(2), 57–70.

Lundgren, I., Begley, C., Gross, M. M., & Bondas, T. (2025). Long-term reproductive health outcomes after successful vaginal birth after cesarean versus elective repeat cesarean section. BMC Pregnancy and Childbirth, 25(1), Article 204.

Magee, S. R., Battle, C., Morton, J., & Nothnagle, M. (2014). Promotion of the family-centered cesarean. MedEdPORTAL, 10, 9845.

Mazzoni, A., Althabe, F., Liu, N. H., Bonotti, A. M., Gibbons, L., Gibbons, P., & Belizán, J. M. (2016). Women's preference for caesarean section: A systematic review and meta-analysis of observational studies. BJOG: An International Journal of Obstetrics & Gynaecology, 123(8), 1296–1302.

McCoy, J. A., Levine, L. D., Wan, G., Chivers, C., Teel, J., & La Cava, W. G. (2025). Intrapartum electronic fetal heart rate monitoring to predict acidemia at birth with the use of deep learning. American journal of obstetrics and gynecology, 232(1), 116.e1–116.e9. https://doi.org/10.1016/j.ajog.2024.04.022

Mini Telemetry: Advanced workflow and a comfortable birthing experience. https://www.gehealthcare.com.tr/products/maternal-infant-care/fetal-monitors/mini-telemetry Access date: May 13, 2026

Mitchell, L., & Khan, E. (2022). Guideline for the use of water during labour and birth. https://www.mkuh.nhs.uk/wp-content/uploads/2022/10/Water-birth-guideline.pdf access date: 13.05.2026

Montoya-Williams, D., Lemas, D. J., Spiryda, L., Patel, K., Carney, O. N. O., Neu, J., & Carson, T. L. (2018). The neonatal microbiome and its partial role in mediating the association between

birth by cesarean section and adverse pediatric outcomes. Neonatology, 114(2), 103-111.

Mueller, N. T., Dominguez-Bello, M. G., Appel, L. J., & Hourigan, S. K. (2020). 'Vaginal seeding' after a caesarean section provides benefits to newborn children: FOR: Does exposing caesarean-delivered newborns to the vaginal microbiome affect their chronic disease risk? The critical need for trials of 'vaginal seeding' during caesarean section. BJOG : an international journal of obstetrics and gynaecology, 127(2), 301. https://doi.org/10.1111/1471-0528.15979

Nutter, E., Meyer, S., Shaw-Battista, J., & Marowitz, A. (2014). Waterbirth: Maternal and neonatal outcomes in a community setting. Journal of Midwifery & Women's Health, 59(3), 253–262.

PelviTwin: Digital Twins and Ultrasound Technology to Prevent Childbirth Injuries (2026). https://www.kth.se/inspirelab/projects/projects-2026/pelvitwin-digital-twins-and-ultrasound-technology-to-prevent-childbirth-injuries-1.1454356 Access date: 13.05.2026

Preis, H., Tovim, S., Mor, P., Grisaru-Granovsky, S., Samueloff, A., & Benyamini, Y. (2020). Fertility intentions and the way they change following birth- a prospective longitudinal study. BMC pregnancy and childbirth, 20(1), 228. https://doi.org/10.1186/s12884-020-02922-y

Rattanasak, A., Jumphoo, T., Pathonsuwan, W., Kokkhunthod, K., Orkweha, K., Phapatanaburi, K., ... & Uthansakul, P. (2025). An IoT-enabled wearable device for fetal movement detection using accelerometer and gyroscope sensors. Sensors, 25(5), 1552. https://doi.org/10.3390/s25051552

Rebenitsch, L., & Owen, C. (2016). Review on cybersickness in applications and visual displays. Virtual reality, 20(2), 101-125.

Royal College of Obstetricians and Gynaecologists (RCOG) (2024). Birth after previous caesarean birth (Green-top Guideline No. 45). RCOG.

Seyyed-Kalantari, L., Zhang, H., & McDermott, M. B. (2021). Underdiagnosis bias of artificial intelligence algorithms in healthcare datasets. Nature Medicine, 27(12), 2176-2182.

Silver, R. M., & Landon, M. B. (2020). What we know about multifetal pregnancy and subsequent placenta accreta spectrum after cesarean delivery. Seminars in Perinatology, 44(4), 151246.

Smith, A. J., & Rahmani, M. (2026). Digitalization of intrapartum care: How wearable fetal monitors support maternal mobility and physiology. Journal of Perinatal Technology, 14(2), 112–125.

Steinberg, S., Wong, M., Zimlichman, E., & Tsur, A. (2025). Novel machine learning applications in peripartum care: A scoping review. American Journal of Obstetrics & Gynecology MFM, 7(3), 101612.

Stevens, J., Schmied, V., Burns, E., & Dahlen, H. (2018). Immediate or early skin-to-skin contact after a Caesarean section: A review of the literature. Maternal & Child Nutrition, 14(4), e12456.

Turkish Statistical Institute (TÜİK) (2024). Birth Statistics, 2024. https://data.tuik.gov.tr/Bulten/Index?p=DogumIstatistikleri-2024-54196 acces date: 13.05.2026

Ullah, F., Iqbal, A., Iqbal, S., Kwak, D., Anwar, H., Khan, A., ... & Kwak, K. S. (2021). A framework for maternal physical activities and health monitoring using wearable sensors. Sensors, 21(15), 4949. https://doi.org/10.3390/s21154949.

Wong, C. A., & McCarthy, R. J. (2023). Effects of modern labor epidural analgesia on newborn outcomes: A comprehensive review. American Journal of Perinatology, 40(8), 845–854.

Vaginal Birth After Cesarean (VBAC): Is It Possible? https://bezmialem.com.tr/Pages/health-detail/125/sezaryen-sonrasi-normal-dogum-ssvd-mumkun-mu acces date: 13.05.2026